

Derailed: A Case Study of the 2001 Baltimore Howard Street Tunnel Fire with Exercises

Instructor Materials



Table of Contents

Instructor Materials for Derailed: Critical Infrastructure Security and Resilience in Exercises	3
Introduction	3
Exercise 1. Building a Robust Information Sharing Environment: Stakeholder Identification using Mind Mapping.	4
Task: Using the information in the case as your starting point, create a mind map of the information sharing environment surrounding the Howard Street Tunnel at the time of the incident.	4
Exercise 2. Building a Robust Information Sharing Environment: Red Hat Information Sharing Matrices	9
Task: Using the case narrative, create information sharing matrices for the case.....	9
Case Conclusion	12
Key Takeaways	13

Derailed: A Case Study of the 2001 Baltimore Howard Street Tunnel Fire with Exercises

Instructor Materials for Derailed: Critical Infrastructure Security and Resilience in Exercises

Introduction

The 2001 Howard Street Tunnel freight train derailment in Baltimore is a compelling case study that illustrates the central role that information sharing plays in critical infrastructure security. The multi-modal and multi-sector consequences in this case—particularly due to the cascading effects of fire, flood, traffic disruptions, and communications and power outages associated with this prolonged event—present a rich opportunity for learners to think critically about how information sharing strategies can be developed and implemented to mitigate risks and improve response.

The goal of the case is to help learners develop proficiency in DHS/IP Core Competencies and to reinforce the learning objectives found in the Information Sharing courses. The *case narrative* emphasizes learning objectives found in the course lessons, specifically those focused on developing public-private information sharing environments, barriers to information sharing, information sharing best practices, and information sharing frameworks.

The case *exercises* build core competencies in Risk Analysis and Information Sharing through a series of exercises that prompt thorough thinking about the full range of information sources and types. In addition, the exercises model individual and group techniques that develop divergent and convergent critical thinking skills and are designed as repeatable, practical methods those learners can apply not only in the course but also in the workplace. Exercise 1 asks learners to use a divergent thinking technique to brainstorm and visualize the full complement of actors in the information sharing environment and their interrelationships. Exercise 2 builds on Exercise 1 by challenging learners to use a Red Hat analysis to identify information sharing dialogues between each of the stakeholders using matrices.

The goal of the exercises is to employ sound critical thinking about building solid information sharing strategies, not simply to model the known outcome. As such, the exercises help the learner employ a robust and structured approach to these activities and explicitly identify the value added by using them. Many times the value of a technique lies in the conversation that it prompts about evidence, factors, assumptions, and gaps that would otherwise be overlooked. Learners should judge their performance, therefore, on *how* they have conducted their analyses rather than on the specific case outcome.

Exercise 1. Building a Robust Information Sharing Environment: Stakeholder Identification using Mind Mapping.

Mind Maps are visual representations or diagrams of a topic of interest. A mind map has two main elements. The first element is the information (people, places, things) that is relevant to the topic being mapped. The second element is the connections (lines, or other links) that illustrate how the information is connected. The spatial placement of the information and connections on the page can help the user to explicate and analyze the relationships among the items being mapped.

Mind mapping is a visual brainstorming technique that sparks not only divergent thinking about all the actors, factors, and forces being mapped, but also convergent thinking about what those interactions reveal about the environment or issue being mapped. It is a flexible technique can be useful before, during, and after an incident to understand the complex relationships surrounding a given issue. A mind map can be a powerful brainstorming technique because it uses a combination of words, symbols, and images to build a picture of a problem that can be easily shared and discussed.

This exercise can be tailored for use depending on group size and time available for mapping and discussion. The most important aspect of the exercise is the discussion that the maps prompt about the information environment, dependencies and interdependences, cascading effects, emergency response, sector-specific issues, information gaps, and assumptions. Whether it is used as an individual exercise or as an in-class or outside-class group exercise and discussion, the map serves as a prompt for discussion of a number of infrastructure-related themes. See the Analytic Value Added Section for more information and ideas for in-class discussion.

Task: Using the information in the case as your starting point, create a mind map of the information sharing environment surrounding the Howard Street Tunnel at the time of the incident.

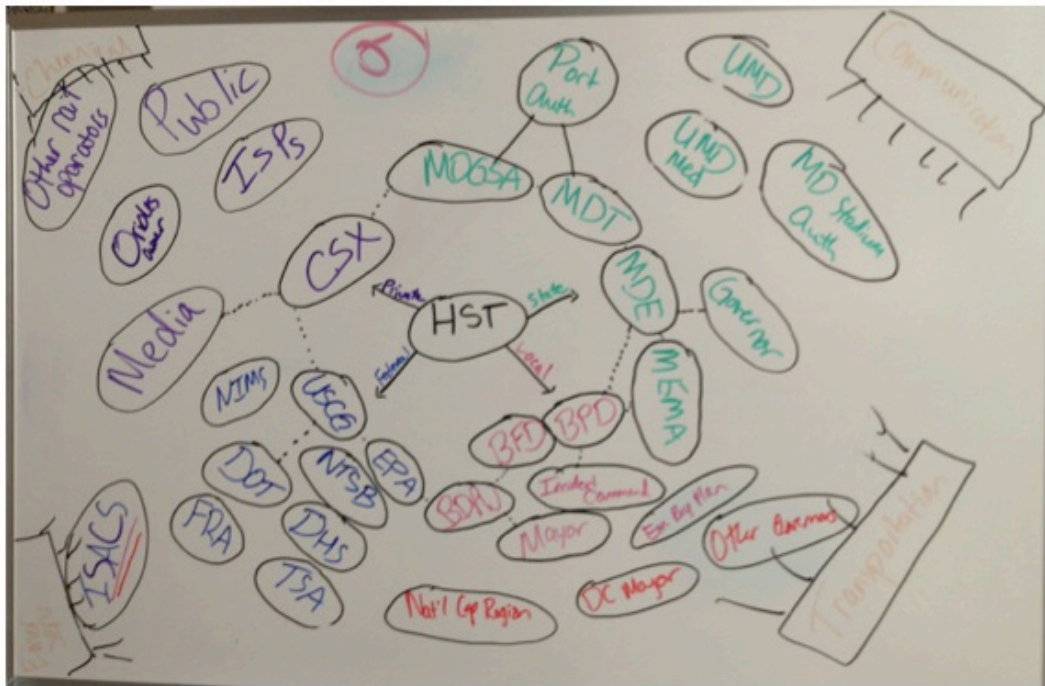
Mind Map Technique Steps

Materials: Paper (large, if possible), and drawing implements (colors help).

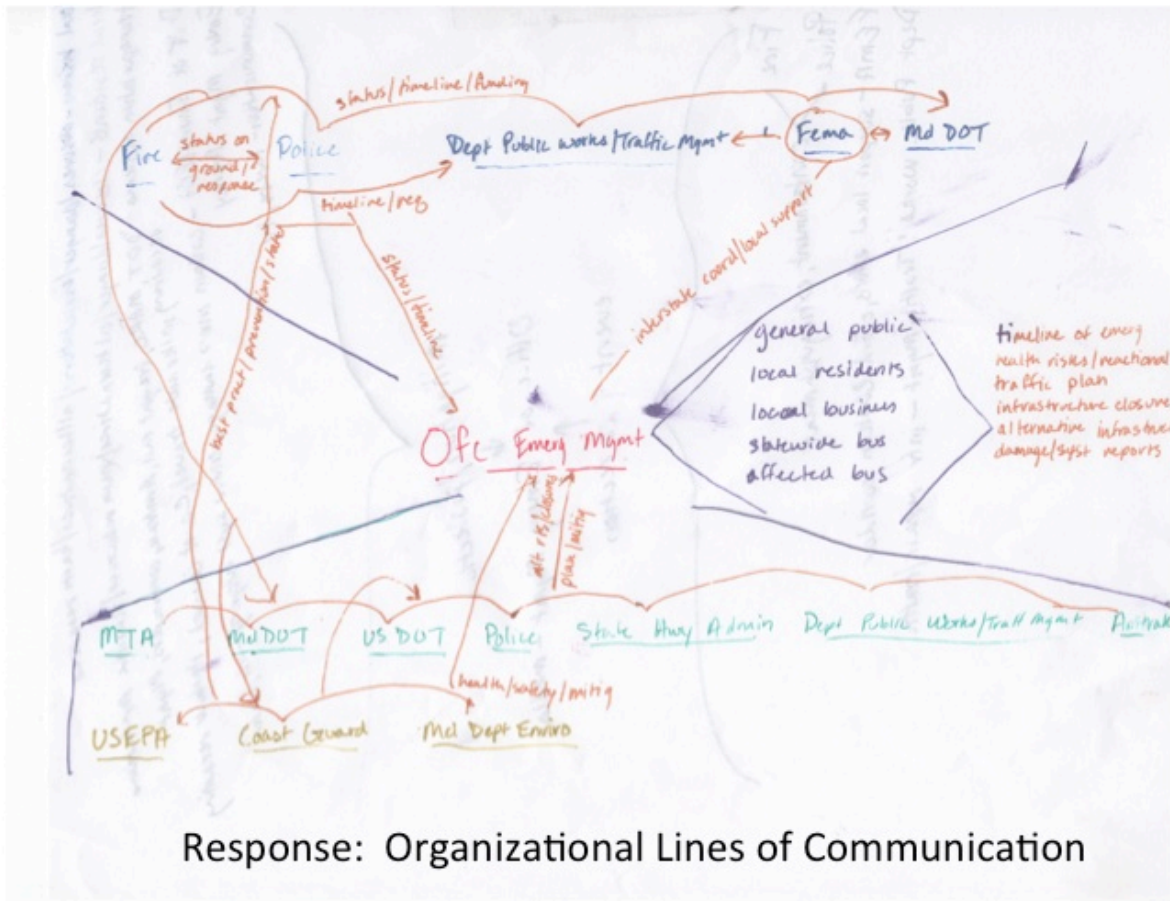
Alternatively, a White Board and colored markers will also suffice. The map can also be drawn digitally using specialized mind mapping software or another program such as PowerPoint.

- Step 1: Identify the focal issue to be mapped. For this exercise, the case is a starting point from which to build a map of the actual information sharing environment surrounding the freight rail line in the Howard Tunnel. If the technique is being used in a planning process the focal question might be to build a map of the ideal information sharing environment. The most important aspect of step 1 is to identify clearly the issue to be mapped.
- Step 2: Make a list of the information (people, places, things, concepts, issues) to be mapped. Start with as many as possible and then group them in a logical manner. For this case, for instance, groupings by critical infrastructure sector or subsector might be instructive.

Figure 1: Organizational Mind Maps

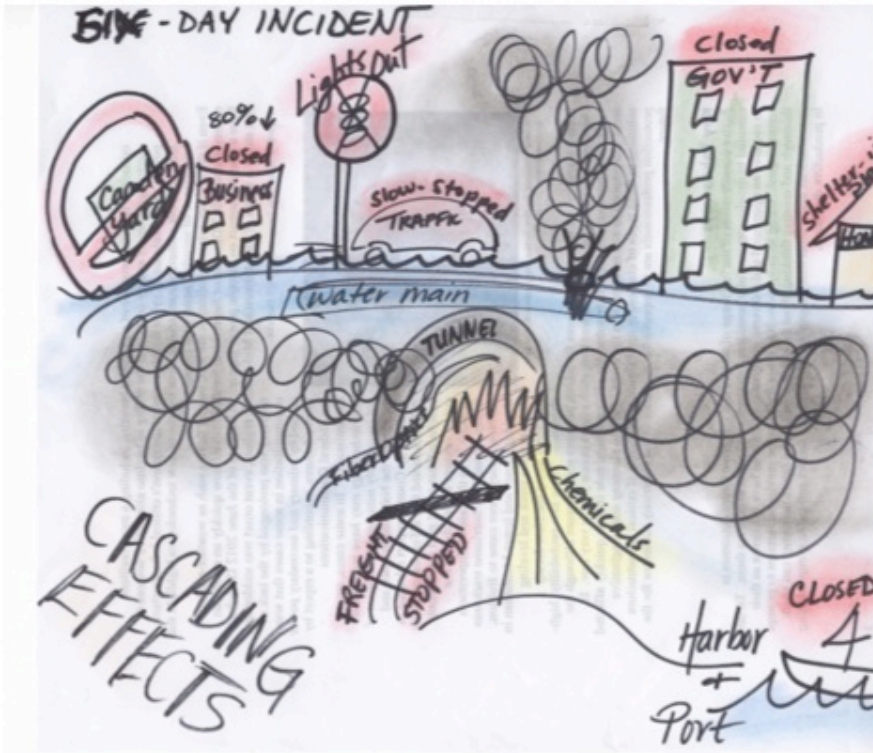


Organizational Relationships and Sectors



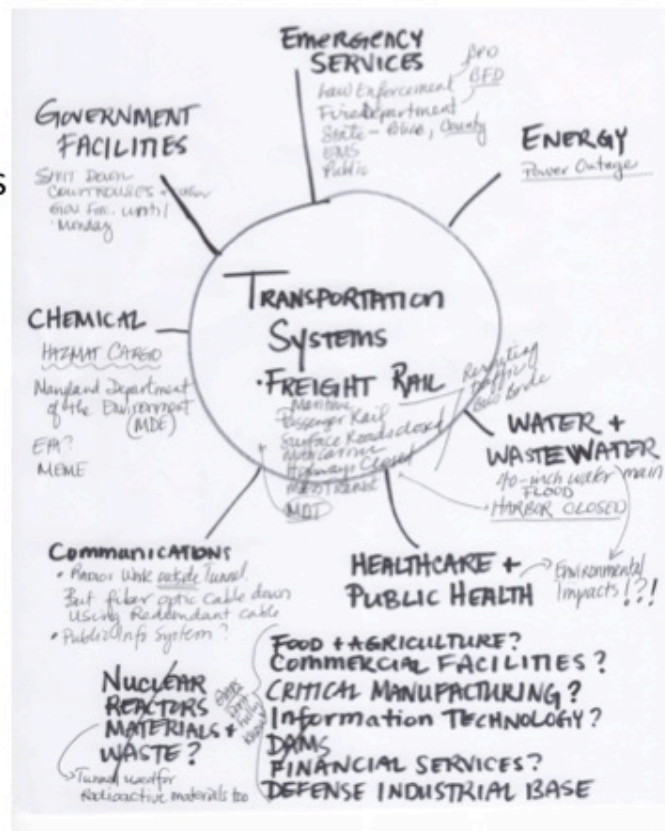
Response: Organizational Lines of Communication

Figure 2: Mind Maps with Effects and Dependencies Focus



“Cascading Effects”

Sector Dependencies
And Interdependencies



- Step 3: Using paper or a white board, array the general groups and more specific concepts on the page so that the most relevant or focal concepts are at the middle of the page. These concepts may be represented by images, symbols or words. The Mind Map presents an opportunity for creativity in this regard that can spark imaginative thinking. Use a pencil or erasable marker as you begin to sketch so that you may refine the placement of the concepts as necessary.
- Step 4: Make links between the related concepts. Use lines, arrows, dotted lines, or other markings to illustrate the information flow. Add labels to clarify the nature of the relationships.
- Step 5: As you build the binary links, look for any tertiary or crosslinks that are noteworthy. Label these links and refine the positioning and labels as necessary.
- Step 6: Consider any additional concepts to be added to the map. Are there any gaps? Are any stakeholders missing who should be there? Are there any links that should be added? Are there any links that in an ideal world should be there but are not?
- Step 7: Add any additional notations to the Mind Map to highlight important connections or interrelationships.
- Step 8: Reposition and refine the map adding color, images, or other clarifying items.

Analytic Value Added

Who are the central stakeholders that emerge from the Mind Map?

- Prompt participants by asking specifically about the roles that each of these organizations played: CSX Transportation, Baltimore Fire Department, Maryland Department of the Environment, Maryland Department of Transportation, Baltimore Police Department.

Which relationships are most important in this case? Are there any binary or tertiary relationships that emerge from the map that should be pursued? What is the nature of the relationships among the concepts on the map?

- Ask participants to identify the most important relationships on their maps. Did others' maps identify different relationships? Prompt deeper consideration by asking whether the most important relationships were static throughout the incident?

What things could be done to improve information sharing environment? Is anything missing (stakeholders or links) from the map that could improve the information sharing environment?

- Are there any relationships that could be improved? What about the role of Maryland Emergency Management Agency or the Baltimore Office of Emergency Management? What about the Maryland State Department of Transportation?

If working with others, compare mind maps. How have others presented their maps and what can be learned from these different perspectives?

- If using this exercise in a small group or in a classroom setting, create a Mind Map “gallery” on the wall by taping the various Mind Maps to the wall or white board. Label each map with a letter or number. Ask the participants to silently observe the various maps, making a note of the label and the key issue that the map most vividly highlights. In plenary or small groups, ask the participants to share their observations and how those observations relate to the information in the case.

Exercise 2. Building a Robust Information Sharing Environment: Red Hat Information Sharing Matrices

Red Hat analysis is a technique that prompts the user to adopt the perspective of another person or group and to conduct an analysis from this new perspective. Shifting one's perspective in this manner is particularly salient when building information sharing relationships because it shifts the focus from one's own information needs to that of one's interlocutors. The goal of developing an information strategy using a Red Hat analysis is to improve the chances of finding common ground and unearthing new areas for collaboration. A matrix is a simple but powerful analytic tool that uses a grid to organize data for easy comparison and analysis of variables. Matrices are particularly helpful when there are more variables to be sorted and compared than the human mind can process and track unaided. The matrix allows for easy binary comparison of all the variables as well as an easy way to identify gaps. Combining Red Hat analysis and matrices can be a helpful way to develop a roadmap for information sharing with numerous stakeholders.

The matrices are designed to prompt thinking about the binary interactions of the various stakeholders. In an exercise setting, the goal is to prompt thinking and discussion, not develop an exhaustive list of actors and information. The examples in the exercise below model the types of actors and information that may be drawn from the case. Instructors may want to direct participants' attention to Table 4 and the Chronology in the case narrative for information that should aid them in completing the exercise. For a more in-depth role-playing exercise instructors may assign roles to the participants. In this case, outside research may be assigned for the various assigned roles or participants may rely upon the case narrative and their own expertise.

Task: Using the case narrative, create information sharing matrices for the case.

Red Hat Information Sharing Matrices Technique Steps

- Step 1: Clearly define the focal issue for the Red Hat Information Sharing Matrices. In this exercise, the focal issue is to identify ideal information sharing relationships between the stakeholders.
- Step 2: Create *two* matrices with the desired stakeholders listed down the left side and across the top. (See Matrices #1 and #2 below) Label the first matrix *Information to Provide*. Label the second matrix *Information to Seek*. Use as many rows and columns as necessary to accommodate the number of stakeholders assigned or desired.
- Step 3: Shade the pairwise comparisons so that the cells in the matrices that compare the same stakeholder are shaded.

Information Sharing Matrix 1: Information to Provide

	Baltimore City Fire Department	CSX Transportation	Baltimore Office of Emergency Management	Maryland Department of the Environment
Baltimore City Fire Department		Current conditions, disposition of train cars and chemicals.	Locational information for fire and conditions in and above site of derailment. Update as necessary.	Information on fumes, liquids, other environmental factors (chemical burns, inhalation issues).
CSX Transportation	Barrier! Radio down in tunnel. Circuitous communications through dispatcher. Report the fire and any pertinent information about cargo or cause.		Offer special expertise (chemical, other HAZMAT) and information on tunnel (logistics, maintenance, grade, other co-located utilities, etc.).	Information on chemicals or other HAZMATs. Offer assistance from CSX HAZMAT teams.
Baltimore Office of Emergency Management	Conditions that will affect fire suppression operations (road closures, chemical release, fumes).	Information on current conditions that may help isolate where in the tunnel the problem occurred and best approaches to fire suppression activities.		Aggregate information received from all responders and stakeholders about environmental impacts.
Maryland Department of the Environment	Background on effects of various chemicals in cargo. Environmental testing. Consult on emergency evacuation vs. shelter in place decision.	Coordinate on environmental testing.	Results of environmental testing. Provide context for decision about evacuation vs. shelter in place.	

Information Sharing Matrix 2: Information to Seek

	Baltimore City Fire Department	CSX Transportation	Baltimore Office of Emergency Management	Maryland Department of the Environment
Baltimore City Fire Department		Pertinent information on containers, HAZMAT, cargo.	Information on above and below ground conditions that will affect fire suppression operations.	Any information on fumes, chemicals, or HAZMAT issues.
CSX Transportation	Questions on cargo or events surrounding apparent derailment		Current conditions, information for the public.	When and where testing is taking place.
Baltimore Office of Emergency Management	Current conditions in fire suppression operations. Information on conditions that may affect public/need to be released.	Any possible causal information that could affect response.		Environmental impacts, even if health impacts are not expected.
Maryland Department of the Environment	Information on disposition of chemical cars. Which chemicals, where, any adverse effects felt during suppression operations.	HAZMAT? Chemicals? How much? Transport containers?	Information on additional resources (local, federal)?	

Step 4: Begin the information sharing analysis by starting with the first stakeholder listed along the left of the Information to Provide matrix.

Working across Stakeholder 1's row, ask: what information does this stakeholder possess that could be shared with Stakeholder 2. List that information in the corresponding cell on the Stakeholder 1 row. Do the same for the Stakeholder 3 and 4 cells on the Stakeholder 1 row. Next, move down the left hand column to Stakeholder 2. Ask the same question: what information does this stakeholder possess that should be shared with Stakeholder 1. The goal is to identify specific information that should be shared with each of the other Stakeholders.

- Step 5: As you identify specific information for each Stakeholder to provide, make a note of any barriers to sharing in the cell. Barriers to information sharing take many forms and should be noted at this stage in the analysis. When encountering a barrier, ask whether the barrier is the Stakeholder's or is something in the environment that is external to the Stakeholder. Note this in the applicable cell.
- Step 6: Once the Information to Provide matrix is complete, conduct the same process using the Information to Seek matrix.
- Step 7: Again, note any information barriers in the corresponding cells.
- Step 8: Track the relationships over time and note any changes to the binary relationships. Do these changes affect any other relationships?

Analytic Value Added

Use the matrices as an opportunity to prompt discussion about the various stakeholders.

- Ask participants to identify which relationships are most or least developed? Are there any barriers to information sharing?

Where do opportunities exist to improve the information sharing relationships?

- What kinds of information and relationships should be improved for the future? For example, the relationship between Baltimore City and CSX Transportation? What kinds of information could be shared between these two organizations? Information about the tunnel? Maintenance? Warning about HAZMAT cargo?

Is there a particular stakeholder that is best positioned to play a leadership role in sharing information? Is there a stakeholder that should be more integrated into the environment and what type of information might they contribute?

- The Baltimore Office of Emergency Management played a role in interagency coordination and public information sharing. Could OEM's role be expanded? How might OEM's role look today vice 2001?

Case Conclusion

In the months and years following the incident, the U.S. Fire Administration and National Transportation Safety Board (NTSB) investigated the cause of the incident and offered recommendations and lessons learned that highlighted the importance of information sharing for incident planning and response.

The U.S. Fire Administration report found that the tactical emergency response was successful in large part due to effective information sharing relationships. Specifically, “the response, fire suppression, and containment activities were successful in part because of previous disaster response planning and field exercises. Mutual aid agreements and a designated command structure provided the framework for coordination and cooperation among city and state officials...and provided the City with critical information on where the Plan could be improved.”¹

Furthermore, the Fire Administration found that the Baltimore Fire Department’s pre-established working relationships with “other City resources and businesses and industries in their area” contributed to the successful response.² These relationships, in combination with a number of other information sharing mechanisms, including the incident management system, emergency management plan, and training and drills, were highlighted as lessons learned from the incident. (See Table #)

Table 1: U.S. Fire Administration Lessons Learned

Media Relations	Designate a Public Information Officer for the duration of the incident. This incident occurred in the afternoon, and by the 5:00 p.m. newscasts, a PIO was still not available. According to Incident Command, inaccurate reports were made regarding the seriousness of the situation.
Maintain Control of “helpers”	Incident Command must maintain control of mutual aid and volunteer resources responding to incident. A few times during the initial incident coordination, volunteer response and representatives from City services left the IC staging area and had to be located for certain tasks to be accomplished.
Maintain Control of Workers	Accountability for personal safety and safe operations is a must during incident response and duration. Incident Command was able to maintain control and accountability of firefighters responding to the scene. As a result, there were no injuries to personnel (other than heat-related) and manpower resources were properly maintained to meet the needs of the incident.
Tactical Response and SOP’s	City management should review and update strategy and SOP tactics for response to tunnel incidents. IC recommends that other cities with a railroad industry collaborate to be successful and comprehensive.
Training and Drills	Expand use of drills and training along with the relationships with the partners involved in response. The value of training and drills cannot be expressed enough. The “what ifs” should include the worst-case scenarios and most complicated response needs. The BFD believed they would remain prepared to respond to incidents of this type and scale with continued training and drills for the entire infrastructure.
Partnership	Develop strong working partnerships with agencies and businesses responsible for responding to incidents. The BFD acknowledges that the incident response was successful because they had established working relationships with other City resources and businesses and industries in their area.
Incident Management System	Expanding on the partnership lesson, this incident demonstrates the importance of training and pre-planning. By instituting pre-defined plans for response that were developed with flexibility to expand during an incident, the partners were able to reach consensus on appropriate response tactics and ultimately expand the operations into a Unified Command Structure.
Emergency Management Plan	The BFD noted that the City’s emergency management plan needed to be reviewed and revised to incorporate technologies, safety, health and environmental impact, and other issues. Major incidents in any city present an opportunity to test under actual circumstances what works well, and what needs improvement insofar as emergency management plans are concerned.
No Serious Injuries	Adherence to Incident Command decisions and cooperation, contributed greatly to a low number of injuries—only two, which were heat-related.

Source: U.S. Fire Administration, CSX Tunnel Fire Baltimore, Maryland, USFA-TR-140/July 2001, page 15.

Despite an exhaustive investigation, NTSB's three-year investigation of the derailment could not identify the cause, in part because "postaccident fire, flooding and necessary emergency response activities...significantly disturbed the accident site."³ However, NTSB simulations indicated, "Neither train operations nor changes in track conditions alone likely resulted in a derailment."⁴ As a result, NTSB concluded, "the most likely derailment scenario involved an obstruction between a wheel and the rail, in combination with changes in track geometry."⁵ NTSB's report also detailed the successful tactical emergency response effort but it found that more strategic-level planning and coordination between CSX Transportation and the City of Baltimore regarding maintenance and modifications to the tunnel "had not been reliably documented or exchanged among the interested parties."⁶

NTSB's recommendations, therefore, focused on further improving information gathering and exchange about the Howard Street Tunnel and its environs. NTSB recommended that CSX Transportation maintain maintenance and inspection documentation and "enhance the exchange of information with the city of Baltimore on maintenance and construction activities within and in the vicinity of the Howard Street Tunnel."⁷ Likewise, NTSB recommended that the City of Baltimore "update and revise emergency preparedness documents to include information on hazardous materials discharge..." and "...infrastructure information on the Howard Street Tunnel," in addition to taking "action necessary to enhance the exchange of information."⁸

In the wake of the incident reports highlighting the danger posed by freight rail transportation of hazardous materials via the Howard Street Tunnel, there were public calls for a new freight rail bypass route around Baltimore. A Congressionally-directed U.S. Department of Transportation Federal Railroad Administration report published in 2005 on the challenges and alternatives for Baltimore's railroad network analyzed possible alternative routes for freight rail. It identified three bypass options—two overland routes and a tunnel route. All of the options proved to be prohibitively costly. The most expensive harbor tunnel option—at approximately \$3.1 billion—was three times more expensive than the two possible above ground routes.⁹ None of the possible routes were adopted.

In 2010 another freight train carrying hazardous materials derailed in the Howard Street Tunnel. This time there was no leak and the materials did not ignite, but the incident sparked memories of the 2001 blaze that had shut down the city for days.¹⁰ The Howard Street Tunnel is still in use for freight rail in 2013. The Federal Railroad Administration estimates that freight rail traffic via the CSX Transportation line will increase by 81% between 2003 and 2050.¹¹ There is not yet an alternate route.

Key Takeaways

- Using an information sharing case that incorporates Mind Maps and Red Hat Information Sharing Matrices is a useful and creative way to guide group thinking and collaboration both inside the classroom and in the real world.

- The exercises emphasize the importance of considering a problem from multiple perspectives. Doing so improves the likelihood of asking the right questions in a fast-paced information environment.

¹ U.S. Fire Administration, *CSX Tunnel Fire Baltimore, Maryland, USFA-TR-140/July 2001*, <http://www.usfa.fema.gov/downloads/pdf/publications/tr-140.pdf>, page 16.

² *Ibid.*, p. 15.

³ National Transportation Safety Board, *Railroad Accident Brief NTSB/RAB-04/08*. Incident Number DCA-01-MR-0004, July 18, 2001, <http://www.nts.gov/doclib/reports/2004/RAB0408.pdf>, page 19.

⁴ *Ibid.*, 19.

⁵ *Ibid.*

⁶ *Ibid.*, p. 15.

⁷ *Ibid.*, p. 19.

⁸ *Ibid.*

⁹ *Report to Congress: Baltimore's Railroad Network Challenges and Alternatives*, U.S. Department of Transportation Federal Railroad Administration, November 2005, <http://www.fra.dot.gov/eLib/Details/L04157>, ES-14.

¹⁰ "Trouble under Howard Street," *The Baltimore Sun*, August 8, 2010, http://articles.baltimoresun.com/2010-08-08/news/bs-ed-csx-derailment-20100808_1_derailment-scenario-train-cars-hazardous-materials.

¹¹ *Report to Congress: Baltimore's Railroad Network Challenges and Alternatives*, U.S. Department of Transportation Federal Railroad Administration, November 2005, <http://www.fra.dot.gov/eLib/Details/L04157>, ES-4.